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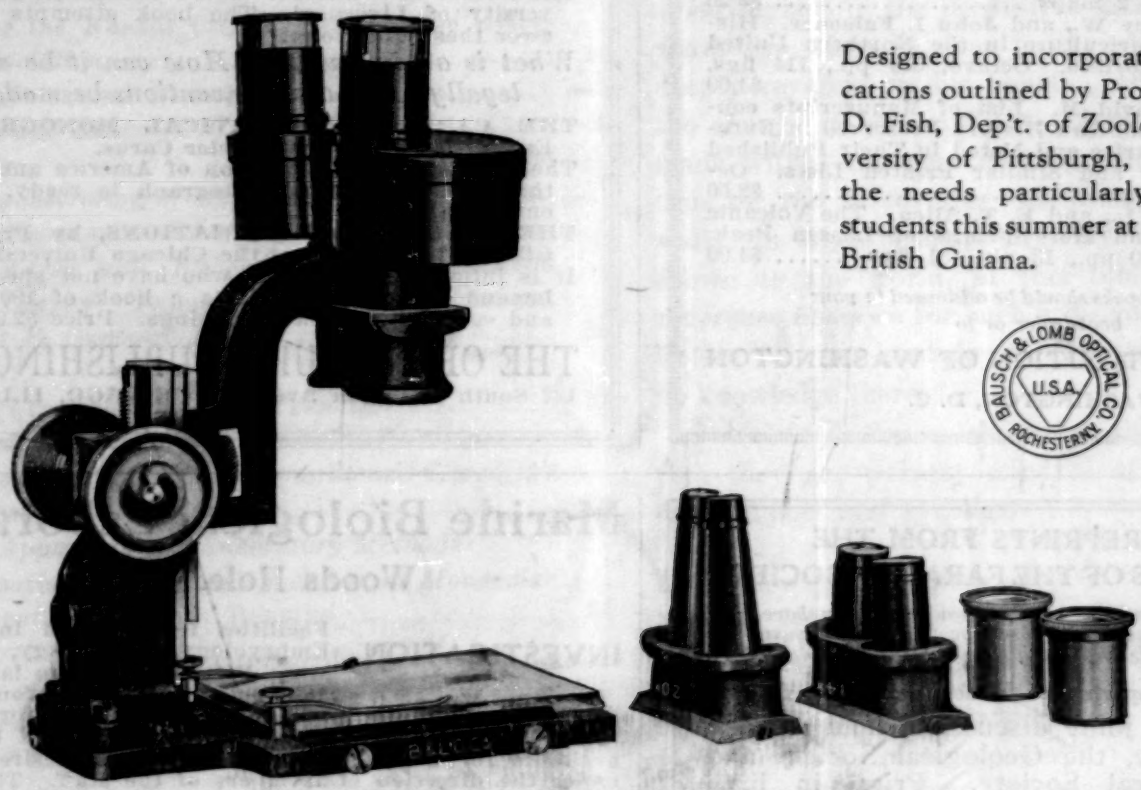

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THE FARADAY BENZENE CENTENARY[1]

AN indescribable feeling of deepest reverence thrills those who know that they are within a holy of holies when standing at this table whence Davy and Faraday and Dewar disclosed their discoveries to the world.

Consider the immensity of outlook it commands. A few days ago, the glories of Tut-ankh-Amen's most wonderful tomb were depicted, in minute detail, upon the screen behind me. We could realize that man stood higher, in the decorative arts, several thousand years ago, than he does to-day—that man was then deeply reverent in his beliefs. In stark contrast is the change in our civilization—we call it advance—made within the past century, through the application of the discoveries discoursed of within these walls: in large measure fired by the tiny spark first shown to the world, at this table in 1831. What reverence have we for such a discovery? Our men of letters pay no heed to it. The public at large has no knowledge thereof.

Chemists desire to show, by this commemoration, that they are persons mindful of the words of the ancient poet and preacher:

Let us now praise famous men
And our fathers that begat us.
The Lord hath wrought great glory by them
Through His great power from the beginning.
Such as did bear in their kingdoms,
Men renowned for their power,
Giving counsel by their understanding
And declaring prophecies:
Leaders of the people by their counsels
And by their knowledge of learning meet for the people,
Wise and eloquent in their instructions.

"Of them that have left a name behind them," Faraday is one of the greatest, certainly the greatest experimental philosopher the world has yet known. A Sandemanian, deeply religious, from his childhood upwards, throughout life, he advisedly kept his "science" apart from his religion but his moral faith was ever the background of his scientific productivity. His work was all conceived and executed in a deeply religious spirit. It will only be by following his example that wisdom will be made the religion of the

[1] Address delivered at the Royal Institution on June 16, at the celebration of the centenary of the discovery of benzene, by Faraday, and printed in *Nature*.

people. He painted himself, his attitude during the whole of his career, in a lecture he gave in 1816, when only twenty-five years old, in saying—

> The philosopher should be a man willing to listen to every suggestion but determined to judge for himself. He should not be biassed by appearances; have no favorite hypothesis; be of no school and in doctrine have no master. He should not be a respecter of persons but of things. Truth should be his primary object. If to these qualities be added industry, he may indeed hope to walk within the veil of the temple of nature.

Speaking at this table, in May, 1854, addressing His Royal Highness, the Prince Consort, who occupied the chair, Faraday said: "I take courage, Sir, from your presence here this day, to speak boldly that which is on my mind." The lecture was on "Mental Education." In it he dealt with the need of self-education, through attention to "natural things," with the object of improving the faculty of judgment and making it proportionate.

"I will simply express my strong belief," he said, "that that point of self-education which consists in teaching the mind to resist its desires and inclinations, until they are proved to be right, is the most important of all, not only in things of natural philosophy but in every department of daily life."

The lecture was a profession of the attitude of mind in which he had accomplished his work.

Taking courage to speak boldly, in the presence of your Grace, I would say that even the world of science, to-day, is in great need of following counsel such as Faraday gave in his incomparable lecture. We are too prone to speculate—often too inconsiderate in speculation—too little alive to our own individual ignorance—too little bent upon cultivating that breadth of vision and proportionate judgment which is at the root of scientific method. Overcome by the ecstasy of practical achievement, we are too little mindful of the public interest: we are doing too little to make scientific method a public possession. Faraday's dream is in no way fulfilled: the spirit of science in no way enters into our commerce, into our industry, into our public life.

Our best way to praise famous men is to take to heart the lessons of their lives. Consider what Faraday did, at this table, to accomplish the exhortation—"Suffer little children to come unto me." He introduced the Children's Christmas courses and in all his lectures endeavored to come down to the level of his hearers. How different this from our modern practice—our entirely selfish use of jargon.

We seek to-day to direct attention to Faraday's special greatness as a chemist. He is generally thought of in connection with electrical discovery, but it is significant that he began his career as a chemist: that he grew up in the severity of a proper chemical discipline: just at the time, however, when electricity was coming into vogue. Inspired by his great master, Humphry Davy, fascinated by the wonderful use Davy had made of the electric current in liberating the alkali metals and in discovering the nature of so common a substance as lime, gifted with marvellous power of insight and unhampered by the mass of detail which encumbers our modern thought, he could not do otherwise than recognize the reciprocal inseparable nature of chemical and electrical phenomena. He ultimately proclaimed the essential unity of chemical and electrical change—not yet generally recognized by chemists, though in these days even matter is regarded as of electrical origin. We have yet to acknowledge Faraday's prescience and the consequences of this, his prime discovery.

The range of his chemical activity is astounding, the more when we consider his slender equipment and the fact that he did almost everything himself. As one of the earliest workers in organic chemistry, he stands pre-eminent. He not only discovered the hydrocarbon benzene but also three of the five chlorides of carbon; moreover he was the first to study the sulphonic acids, a class of compound now of the first technical importance. His achievement in making these acids was akin, in principle, to that by which Montgolfier's balloon was changed into the airship of to-day, by the introduction, into the car, of the internal combustion engine with its propeller. Naphthalene is an unwieldy hydrocarbon which floats upon water but can not swim in it, being insoluble—Faraday, by introducing the elements of sulphuric acid, made it soluble and mobile. The discovery has been of infinite service in the dyestuff industry. Faraday was one of the first to examine caoutchouc. His name is associated, for all time, with the liquefaction of the gases. He also studied alloys of iron, optical glass and gold in the finely divided state—each an inquiry of major consequence. Many minor issues were examined, always with perspicacity.

The discovery upon which we base this commemoration, that of benzene, will always rank as one of the most fundamental discoveries of chemistry. If not the entire hub of the organic section of our chemical universe, benzene is at least a major part thereof. Our edifice, in fact, has two foundation stones: one, the simple carbon atom, which can be extended endlessly, as links are, in a chain; the other, a closed complex unit or block of six carbon atoms, ranged as in the diamond and associated symmetrically with six atoms of hydrogen. This latter we call benzene. It is, in fact, just a bit of diamond, mounted and pre-

served in hydrogen, as though this were *aspic*. The beauty of the diamond, however, is as nothing compared with that of benzene in the eyes of its many mistresses.

Faraday separated benzene from the products of the decomposition of oil by heat. He seems to have taken an interest in these products so early as 1818 but did not come into possession of the material for their study until April 26, 1825. Beginning the investigation on this date, he soon isolated benzene and may be said to have discovered it on May 24, the day on which he first determined its composition, by an operation itself a wonderful experimental "tour de force"; the memoir in which he submitted his discovery to the Royal Society is dated June 16. Having studied a material such as he used and knowing its complexity, I marvel at the rapidity with which he carried out the inquiry and the accuracy of his deductions. It is a work of astounding genius.

In those days, formulae were scarce known. Dalton had but recently put forward his atomic theory. Faraday, however, was already alive to their use and called his product bicarburetted hydrogen, C_2H, the value then assigned to carbon being half the present value. He gives the data for the molecular formula, C_6H_6, though molecular formulae were unthought of then. About ten years later, the hydrocarbon was prepared from benzoic acid, by Mitscherlich, who altered the name to *benzin*, which Liebig changed to *benzol*. Later (1834), the systematist Laurent introduced the use of the terminal *ene* (ène); alternatively, he proposed the name *phéne* (from φαίνω, to shine), whence phenyl.

The classic academic event in the history of benzene was the introduction by Kekulé, in 1860, of the conception of a closed system of carbon atoms typified by the world-renowned hexagonal formula. He has told us how the idea first came to him when going home to his lodgings on the top of a London bus. Since then, benzene and its derivatives have been the subject matter of a vast volume of inquiry by all the nations: German chemists, however, were long the leaders.

Attention was first specially directed to the presence of benzene in coal tar in 1845. The process of extracting it was devised, in 1849, by Mansfield, working in Hofmann's laboratory in Oxford Street, London. To-day, the gases formed on heating coal to redness, either in manufacturing town's gas or metallurgical coke, are most carefully stripped of benzene and allied hydrocarbons. Our output of "crude benzol" is estimated at 22,000,000 gallons, which is mostly used as motor fuel. Certain petroleums contain considerable quantities of benzene hydrocarbons.

Benzene only acquired technical importance from 1856 onwards, when our countryman, William Henry Perkin, entered upon his great adventure, at the age of nineteen. He not only discovered the first aniline color, mauve: he also founded the artificial dyestuff industry. To-day, the natural coloring matters are all but displaced by dyestuffs, often superior, derived more or less directly from benzene.

Nothing that has happened since Faraday made his discovery would have given the philosopher greater pleasure than the advance in our knowledge of the origin of color—a subject which once filled his mind. Turning to his remarkable correspondence with the Swiss chemist, Schönbein, whose name comes next to those of Priestley and Lavoisier in the history of oxygen, we find Schönbein, in a letter dated Oct. 17, 1852, writing to him as follows:

> Entertaining the notion that in many, if not in all cases, the color exhibited by oxycompounds is due to the oxygen contained in them or, to express myself more distinctly, to a peculiar chemical condition of that body, I have continued my researches on the subject and obtained a number of results which I do not hesitate to call highly curious and striking. . . . I am nearly sure that you will be pleased to repeat the experiments, for either by mere physical means or by chemical ones you may make and unmake or change the color of a certain substance without altering the chemical constitution of those matters. To my opinion, that wonder is performed by changing the chemical condition of the oxygen of the oxycompound.

To this Faraday replied on December 8:

> Your letter quite excites me and I trust you will establish undeniably your point. It would be a great thing to trace the state of combined oxygen by the color of its compound, not only because it would show that the oxygen had a special state, which could in the compound produce a special result—but also because it would, as you say, make the optical effect come within the category of scientific appliances and serve the purpose of a philosophic induction and means of research, whereas it is now simply a thing to be looked at. Believing that there is nothing superfluous or deficient or accidental or indifferent in nature, I agree with you in believing that color is essentially connected with the physical condition and nature of the body possessing it and you will be doing a very great service to philosophy if you give us a hint, however small it may seem at first, in the development or, as I may even say, in the perception of this connection.

Before you are two specimens, one of quinol, the other of quinone, one colorless, the other colored—yellow. Quinone is the type of all organic coloring matters. In quinol, the simple molecule of water, H·O·H, less an atom of hydrogen, is introduced

twice into benzene, in place of two of its atoms of hydrogen: it is colorless. Remove from it two atoms of hydrogen, one from each of the two OH groups: the product, quinone, is yellow in color. It is as Faraday supposed—the condition of the oxygen is altered and certain centers in the molecule become active absorbents of the light waves.

I have ventured to hang upon the inward wall of this great fortress of science, which Faraday occupied to such wonderful purpose, "a banner sable, trimmed with rich expense," bearing a strange device emblematic of benzene. Faraday's initial is enclosed within the hexagon which symbolizes his discovery. This symbol is one that we may aver will last for all time, as upon it may be welded all the facts relating to benzene. It is probably the most significant symbol ever devised, for it has veritable volumes of meaning in the chemist's seeing eye. From it the colors irradiate—though not precisely in prismatic order. Color, at its first appearance, is either yellow or blue, according to the type of compound, yellow being always associated with simplicity of type. As molecular complexity is raised, yellow is gradually intensified and passes into the richest red. Blue, in like manner, becomes intensified and may pass into green, which is the forerunner of black. The changes are due either to changes in the weighting of the absorbing centers or to their cumulative repetition and cooperative action.

Behind me is a curtain of wondrous texture and color, dyed with *Jade green,* one of the latest and most valuable, certainly the most remarkable of the anthracene vat-colors: it was first made in Scotland. Mark its symbol—it is benzene soldered upon benzene, many times over: a *Nonaphene.* The two lone, unsociable, oxygen atoms are the main cause of its color. Note the wonderful change in color when these oxygen atoms are wedded each to an atom of hydrogen—now the *Jade green* becomes a salmon-red, with a most remarkable fluorescent sheen, indicating a simplification of the light-absorbing mechanism. The big hank of viscose silk across the green curtain is dyed with the material in which the green has been thus welded to hydrogen: if oxygen be allowed to take away the hydrogen, the dyestuff again becomes green, may we not say, with envy. Note also this intensely blue hank. In *Jade green* the oxygen atoms are related as are my thumbs when I so juxtapose my fingers that the backs of my two hands are in the same plane. Turning one hand round, my thumbs become related diagonally. Making a like change in the molecule of *Jade green,* converting the dibenzanthrone into isodibenzanthrone, the color passes into blue: wed the oxygen with hydrogen, it passes into red of a blue shade. We can picture what would have been Faraday's and Schönbein's ecstasy of delight at seeing their prophecy verified in such chameleon-like behavior.

I have referred to viscose silk. What would Faraday have said, if told that we had not only found "tongues in trees" and gone far to discover "good in everything" but also that, spider-like, we had made the mere timber of trees into a veritable silken web, carrying colors of every hue made from his benzene, a material found worthy of notice even by a chancellor of the exchequer and actually worn not by queens alone but also by most of their female subjects? Could we tell him these things, might he not well ask what is left for poor nature to do: at the same time, he would be the first to recognize that we had studied "natural things" to some purpose and had he foreseen the power chemists were to wield over nature, he would perhaps have elected to remain a chemist and have thought little of electricity—as do chemists to-day.

We may go further still in tracing the scientific progress of benzene. It is written that "the last shall be first." Benzene, however, retains its dominance and is everlasting. The discovery of the first Fullerian professor, benzene and its descendants are now the objects of most serious attention by the latest holder of the chair. Racked upon his goniometer, tortured by X-rays, they are being forced to disclose the secrets of their inmost atomic centers: their molecular dimensions are being determined in ultra-microscopic terms. Faraday would not have been surprised: he would have been the first to welcome such achievements but with reverence, as well as delight at our progress.

By some uncanny mental process, the chemist has prophesied what X-rays are justifying; and now a new era is upon us, one for which we must prepare ourselves. Like Faraday, we must have many-compartmented minds. We must learn to think in the solid. The chemistry of the future will be spatial in dimensions and distribution. It will be in no slight degree a science of solid geometry. I have here a model of benzene in terms of units such as X-rays reveal to us in the diamond. Mr. William Barlow and I desire to lay this to-day upon Faraday's table as a solid tribute to his memory: it is something more than a mere symbol: we believe it to be a very close approach to the geometrical structure of the molecule. It is something I have hoped for during the whole of my life. There are other models here, made by Mr. Barlow, of various derivatives of benzene, all in close accordance with crystallographic data.

To return to color, the color-chemist to-day is a super-magician. If women could be scientific, they would insist upon being stamped all over, not with a king's cartouche, such as we have seen was used on Tut-ankh-Amen's tomb; no, with the hexagon symbol of benzene, as the emblem of the colors in which they are now arrayed far more gloriously than were ever the lilies which Solomon, we are told, could not rival. To-day, we can paint the lily with its own color. We make the colors of the lily, indeed those of most flowers, in the laboratory, actually from benzene. Faraday, in Sandemanian moments, would almost have regarded this as sacrilege.

To-day is no common occasion and we desire to deal with it in no common way. This commemoration is held at the instance of a remarkable and unusual conjunction: by the Royal Institution, acting together with the Chemical Society, the Society of Chemical Industry and the Association of British Chemical Manufacturers—a trinity completely representative of English chemical interests. Chemists desire to show that for once they can think together. We together acclaim the memory of Faraday—of Faraday the complete philosophic chemist. Moreover, our committee has decided to take in hand the preparation of a medal, to be awarded at intervals, perhaps sexennially, without regard to nationality, for an outstanding achievement in some clear relation with Faraday's discovery of benzene. We desire not only to keep his influence alive but also to extend it. We propose to follow a well-known practice of the clergy and make the first award, in anticipation, to-day. We ask Mr. James Morton, of Carlisle and Grangemouth, to accept promise of the first Faraday Benzene Centenary Medal, in special recognition of the signal service he has rendered to chemical science and industry in Great Britain, during the past ten years, by developing and extending the manufacture of the anthracene vat-dyestuffs and, more recently, by extending their application to silk and wool.

HENRY E. ARMSTRONG

EVOLUTION AND EDUCATION IN THE TENNESSEE TRIAL

PROFESSOR OSBORN has taken a very active part in the scientific side of the Tennessee trial, following conferences between himself and Dr. George W. Rappleyea and Mr. John T. Scopes, in which he was assured of the thoroughly sincere motives that prompted these young Tennesseans to bring on this great trial. It is interesting to note that Mr. Scopes studied evolution under Arthur M. Miller, professor of geology in the University of Kentucky, who took his degree of doctor of philosophy under Professor Osborn.

Great interest in this trial has been manifested in the British press, and Major Leonard Darwin, son of Charles Darwin, cabled to Professor Osborn asking if he could be of any help, prepaying a cabled reply. In response to Professor Osborn's advice, Major Darwin sent to Mr. Scopes the following letter:

I have been requested by my council to express their great sympathy for you in your courageous efforts to maintain the right to teach well established scientific theories. To state that which is true can not be irreligious, and it is only those who have studied the question insufficiently who deny the broad fact of organic evolution; though how it came about is still a matter of dispute and is likely to remain so for some time. In this country ministers of almost all denominations are allowed openly to proclaim their belief that man has been evolved from some lowly organisms by an unbroken series of modifications; a series somewhat similar to that by which each individual has certainly been developed from a baby and ultimately from a minute living germ. Those who declare that the one process—that of racial evolution—is more contrary to spiritual ideals than is the other process—that of development from an infant, are placing unnecessary stumbling blocks in the paths of all those of their hearers who are not wholly irreligious.

In conclusion, may the son of Charles Darwin send you in his own name one word of warm encouragement.

Yours very faithfully,

(Signed) Leonard Darwin, President,
Eugenics Education Society.

Mr. Bainbridge Colby requested a series of statements from the scientific advisers in the case, Messrs. Osborn, Conklin, Pupin, Metcalf, Rice, Miller and Lane, as to the relation which evolution bears as part of educational discipline, not only in zoology and anthropology, but in every branch of science. The scientific advisers complied with written statements in the form of sworn affidavits which Mr. Colby might use if he desires as testimony in the trial. The statements of Professors Metcalf and Rice were not in duplicate and can not be reproduced here, but those before us are as follows:

By Arthur M. Miller, professor of geology, University of Kentucky.

The affiant, Arthur M. Miller, states that for thirty-three (33) years last past he has been and now is the head of the Department of Geology at the University of Kentucky, and for a portion of said time he was also the head of the Department of Zoology of the said University; and that from his experience as a student and teacher of geology and biology, he affirms that it would be impossible to properly present these subjects to students without implicitly or explicitly accepting the doctrine of evolution as true—as much as the Copernican

theory in astronomy or the doctrine of the conservation of energy in physics; and that should a teacher attempt to exclude evolution as true from a presentation of geology or biology, he would find himself without authoritative text books on the subjects to put into the hands of his students.

In witness whereof, the said affiant hath hereunto set his hand at Lexington, Kentucky, this 1st day of July, 1925.

(Signed) Arthur M. Miller

Subscribed and sworn to this 1st day of July, 1925.

By Henry Fairfield Osborn, research professor of zoology, Columbia University.

The teaching that creation has been gradual and not sudden—a matter of millions of years and not of a few hours—that all processes of the formation of the earth have taken enormously long periods of time, that all living things, plants as well as animals, attained their present form and perfection by gradual instead of by sudden means, that man himself is the result of a very gradual process of creation rather than a suddenly formed and finished product—this teaching is what we call *evolution,* for want of a better word. The attempt is made by men who do not understand it and who know nothing about it, who have never studied it, who have never closely observed a plant or an animal nor the structure of man, to show that this teaching is revolutionary and contrary to human knowledge and human welfare. This attempt is absolutely false, untruthful and ignorant, it is contrary to the intelligent teaching of the entire civilized world to-day; it is contrary to what is being taught in the Christian countries of the world and in all the Christian states, except only in certain of our own states where the gradual processes of creation have been grossly misrepresented and even ridiculed. The idea of gradual creation known as evolution is essential in education and every branch of human welfare—in medicine, anatomy, surgery, plant and animal industry, the application of geology as well as zoology, psychology, human origins, cultural and anatomical. It is only through our knowledge of the relationships of man with the lower animals that great discoveries and beneficent discoveries have been made in combatting disease, beginning with vaccination against smallpox and coming down to the cure of diseases like diphtheria and the treatment of all the germ diseases, where it has been found that the animals most closely related to man yield most readily to the treatment that helps man.

No act of any legislature in the world can take evolutionary teaching out of education, because it has become an essential and integral part of education. Nor can we take it out of the teachings about man. While possessed of a superior spirit which we call the soul, man in his anatomy is absolutely one with the rest of the mammals, bone by bone, muscle by muscle, blood vessel by blood vessel, gland by gland, tooth by tooth. Man is no exception to the rest of the animal world nor to the rest of the universe, and no act of legislation can change him. No teacher can possibly teach zoology or any other branch of science truthfully and intelligently if evolution is left out; the cutting out of evolution from education is exactly like taking the heart from the body, for evolution is at the very heart or center of all education and will always be so. In astronomy the evolution of the stars has recently been demonstrated; in chemistry and physics the evolution of the chemical elements has recently been demonstrated. Thus the entire universe is shown to be the product of gradual evolution rather than of special and instantaneous creation.

Henry Fairfield Osborn,
Research Professor of Zoology, Columbia University
President, American Museum of Natural History

Subscribed and sworn to this 3rd day of July, 1925.

By Henry Higgins Lane, professor and head, department of zoology, University of Kansas.

Henry Higgins Lane, being first duly sworn, says:

First, That he has been a student of biological science for thirty-three years; a teacher for twenty-six years; and an investigator in biology for twenty-three years.

Second, That he has been connected with colleges and universities for twenty-six of the past thirty years, twenty of which have been spent in the capacity of head of zoology or biology departments. At present he is professor and head of the department of zoology at Kansas State University.

Third, That he is the author of a book entitled "Evolution and Christian Faith," in which are set forth his conclusions as to the evidence for the doctrine of evolution as well as the relations of that doctrine to the Christian religion.

Fourth, That he has uniformly found in his experience both as a student and as a teacher, that the doctrine of evolution is a necessary foundation for the correct understanding and teaching of such subjects as general biology, zoology, human and comparative anatomy, psychology and anthropology. That the whole field of successful scientific plant and animal breeding is based upon the application of the laws of evolution and genetics to the problem of the development and improvement of domesticated forms of life.

Fifth, That as a result of fourteen years teaching in a medical school, he is convinced of the absolute necessity of a knowledge of evolutionary principles for the proper understanding on the part of the medical student of many of the abnormalities and variations in structure and function of organs with which the physician and surgeon is called upon to deal in the practice of his profession.

Sixth, That as a student and teacher of vertebrate paleontology he has found the whole geological record to be a hopeless muddle, without sense or plan, unless explained on an evolutionary basis.

Seventh, That every line of evidence, whether from the classificatory system, comparative anatomy, comparative embryology, comparative physiology, the environmental relations of organisms, geographical distribution, paleon-

tology, genetics or biochemistry, consistently supports the evolutionary doctrine, and that otherwise the whole edifice of biological science is without meaning and valueless.

Eighth, That in his opinion man's bodily structure, physiological processes, mental faculties, embryological development, and division into numerous races and subraces, all point unmistakably to a human origin out of lower forms of animal life.

Ninth, That the whole trend of the doctrine of evolution when fairly stated is to establish the ideas:

(1) That *God* is everywhere present, and at work in his creation now, as well as in the past.

(2) That He is working according to a well-defined *plan* discernible in the phenomena of nature.

(3) That in this plan, *man* is the crowning product of creation.

(4) That the evolutionary doctrine as applied to man and human affairs, is ennobling, uplifting and productive of optimism as to man's future.

(5) That there is nothing in the evolutionary doctrine when fairly considered that in any way conflicts with true religion or a fair interpretation of the Bible.

(6) That the account of creation, in the first chapter of Genesis, leaves untouched the *method* of creation, and allows for an evolutionary process as clearly as such a brief account could do when its real purpose is kept in mind.

(7) That the scientific doctrine of evolution is in *no sense* atheistic or materialistic, but strongly supports the theistic and idealistic philosophy of the universe.

(8) That the doctrine of evolution leaves the truths of Christianity exactly where they have aways been, *i.e.*, free to stand or fall on the basis of their own intrinsic evidence and the experience of Christiandom.

(Signed) Henry Higgins Lane

Subscribed and sworn to this 1st day of July, A.D., 1925.

Professor Osborn also hurried through the press of Scribner's for wide distribution in the state of Tennessee especially his small volume, "The Earth Speaks to Bryan," a collection of religious and scientific essays written especially to meet the point of view of the Fundamentalists. Mr. Bryan has made continued and effective use of W. A. Bateson's Toronto address of December, 1921, from the time of its appearance in print to his recent article in the July *Forum.* In two issues of *Nature* (June 13 and 20) appears in full a paper by Professor Osborn presented to the National Academy of Sciences at the April meeting, entitled "The origin of species as revealed by vertebrate paleontology." The facts established by the years of research culminating in this paper are partly restated in popular language in "The Earth Speaks to Bryan."

HENRY FAIRFIELD OSBORN
COLUMBIA UNIVERSITY

ASA GRAY[1]

THE career of Asa Gray has great beauty, indeed it has the dramatic quality which comes of humble origin, far-seeing ambition, persistent effort, large accomplishment and wide recognition.

Born in 1810 at Sauquoit, Oneida County, New York, he was of English and Scotch-Irish ancestry. His parents, humble in situation, were of staunch qualities and great industry. His father, who had had but six weeks of schooling, was a tanner and like most early settlers also a farmer. In boyhood Asa was employed in the homely occupations of the farm and among other duties had the monotonous task of driving an old horse around a circular course to propel the crude mill which crushed the bark used in his father's tannery.

His parents had the Scotch piety and reverence for learning. How soon his education was begun may be inferred from a pretty story gleaned from one of the most authentic accounts of his childhood. His father promised him a spelling book of his own when he could spell all the words up to *baker,* which being of two syllables marked a notable advance. In a few weeks he had accomplished the task and was duly rewarded. Next day as he entered his school, not being permitted to speak to the teacher to proclaim his triumph, he marched past her desk waving his new spelling book before her. This was a little before he was three years old.

With intellectual ideals so early inculcated and so eagerly accepted it is not surprising that he did well in his schooling and that even a college education was contemplated for him. This, for financial reasons, did not prove feasible. Instead, at the age of sixteen, he entered a country medical school. Here he chanced to read an encyclopedia article on botany. He was so interested that he bought Amos Eaton's Manual of Botany and by the aid of this quaint little volume began the study which his own talents were destined so greatly to develop and enrich.

From this simple beginning his progress was rapid. At 17 he was assisting a country doctor; at 20 he had graduated from his medical course and was teaching several of the natural sciences in a boys' school at Utica. When 25 he wrote his "Elements of Botany," a work of unusual clarity and for its period of unsurpassed excellence in America. He had already conducted a course in botany at Hamilton College and was the following year chosen curator of the collections of the New York Lyceum.

By Dr. Torrey he was invited to collaborate on his

[1] Address at the unveiling of the Gray bust in the Hall of Fame, May 21, 1925.

Flora of North America, one of the most difficult and ambitious undertakings of its period. At 28 he was appointed to a professorship in the newly projected University of Michigan and commissioned to make an extended journey in Europe for the selection of books and equipment.

Nothing in Dr. Gray's whole career better illustrates the extraordinary qualities of the man than this first trip abroad. He was both in England and on the Continent received with a kindliness and cordiality which can only be explained by the singularly endearing qualities he must himself have possessed. That was not an epoch in which America was particularly popular abroad. Yet this country-bred American youth became at once the welcomed guest of Sir William Hooker, destined to be the director of the Royal Gardens at Kew. He received personal attention and aid from Robert Brown, the most eminent botanist of the British Museum, and from the distinguished botanists at Paris, Lyons, Montpellier, Padua, Trieste, Vienna, Munich, Geneva, Halle, Berlin and Hamburg. With all these he established friendly relations which continued through life and resulted in a steady interchange of specimens and literature between Europe and America of incomparable value to science. No American scientist, not even Agassiz, himself of European birth, has contributed so much to relations of friendly cooperation across the Atlantic.

In 1842 Gray was chosen to fill the newly created Fisher Professorship of Natural History at Harvard, a position which he continued to hold to the close of his career.

From 1845 to 1870 there occurred the great transcontinental surveys and exploring expeditions which brought in an immense mass of scientific specimens illustrating the flora of the western half of our continent. No one was so well prepared as Gray to classify and publish upon this material, and to him the greater part of it was sent. No one can ever again have such an opportunity. There are no more continents to be opened up in this way. Gray with eagerness and industry, with keen insight and sound judgment devoted himself to this gigantic undertaking. His scientific output was enormous. His writings comprise upward of 400 titles. He was scrupulously careful about his style and even his most technical papers have great finish and lucidity.

Personally he had a charming nature and was the ever welcome associate of that memorable group of talented men of whom Longfellow, Norton, Agassiz, James Russell Lowell and Oliver Wendell Holmes were members. He married Jane Loring, a beautiful daughter of one of Boston's fine old families. Together they made several journeys to Europe which were notable in extending the personal cordiality between New and Old World scientists.

He was a warm friend of Darwin and was the first to publish in defense of Darwin's position when it was subjected to prejudiced and unreasonable attack.

In the seventies Gray again attempted a flora of North America. It had grown to be a task far beyond the powers of any one writer. There can be no surprise that one lifetime was not sufficient for its completion. We can only marvel at the extent and excellence of what he did accomplish.

Gray was fortunate in the period during which he lived. His opportunities were unrivaled. Our country was even more fortunate in having at this epoch a scientist of Gray's acuteness to deal with its botanical problems. Otherwise they would have fallen largely to Old World investigators.

B. L. ROBINSON
HARVARD UNIVERSITY

SCIENTIFIC EVENTS

A SECOND TEN-YEAR INDEX TO CHEMICAL ABSTRACTS

THE American Chemical Society is planning to publish a collective index to *Chemical Abstracts* which will cover the period 1917 to 1926 inclusive. This project has been started in 1925 because it is necessary to obtain advance subscriptions to cover the greater part of the big expense and because an early decision as to the feasibility of issuing the index will favorably affect the economy of preparation and date of appearance. The advance subscription blanks were sent out by Secretary Charles L. Parsons, Mills Building, Washington, D. C., on May 9 and up to July 1 a little less than one third of the 3,000 advance subscriptions estimated to be necessary to insure publication had been received.

In view of the fact that *Chemical Abstracts* has stressed completeness in covering the literature of chemistry, the index, if published, will serve as a key to virtually the whole of the world's chemical progress during its most active ten-year period. It is estimated that 7,000 pages of double-column fine print will be necessary to index this literature by authors and by subjects as planned. This will make six big volumes. The subject index will be an index of subjects, not of words (there is a big difference), and it will be based on abstracts, not merely on titles.

It is not thought that the importance of this project needs emphasis. The first Decennial Index to *Chemical Abstracts* was well supported and has proved its

usefulness. The second Decennial Index, because it will cover a period more active chemically, should be even more useful. To help in making the project possible by entering an advance subscription order will not only be a good investment as a personal time saver and from a strictly financial point of view (the few remaining sets of the first Decennial Index are selling at double the original price), but also it will be a good investment in service to chemistry, more particularly to chemistry in America (the foreign abstract journals regularly publish collective indexes). Most scientists are anxious to aid the cause of science, realizing as they do that science is a good servant of humanity. Those of us responsible for *Chemical Abstracts* like to think that the journal plays an essential rôle in the development of chemistry. The success of this second Decennial Index project is of vital importance to the future of *Chemical Abstracts*.

E. J. CRANE

OHIO STATE UNIVERSITY,
COLUMBUS, OHIO

THE ORTON MEMORIAL LIBRARY OF GEOLOGY

IN 1916 General Edward Orton, Jr., generously proposed to the board of trustees of the Ohio State University to establish a library of geology in memory of his father, Dr. Edward Orton, the first president and the first professor of geology in the institution. Accordingly the trustees designated two rooms in Orton Hall for that purpose, and under General Orton's direction they were transformed into beautiful quarters, and the library was opened November 1, 1917.

It was thought that the rooms would be adequate for a long time, but in a few years stack room became scarce. General Orton then offered to equip larger quarters in Orton Hall if space could be found. Finally the commodious room with balcony which for years in large part housed the university library was offered. This was thoroughly remodeled and handsomely furnished. The shelves, tables and cases not only meet the best library demands, but they are very pleasing to the eye. Over the shelves hang oil paintings of geological scenes. Among these are a Moran of the Petrified Forest, a Bierstadt of Old Faithful and a Vollweider of the Alps. The new library was ready for use on January 5.

The books number about 11,000 and include many of the largest and most important sets published here and abroad. They include the university collection, the State Geological Survey exchanges, the library of the late Professor Charles S. Prosser and numerous volumes from the library of Dr. Orton. For the past five years General Orton has supplied $500 annually for the purchase of books. Volumes donated are bound by the state without expense to the library.

Under such favorable conditions the collection, of course, is growing rapidly. Stack room for perhaps 25,000 is provided, and by connection with a room below at least 50,000 volumes can be housed. It is a library not only for the Ohio State University, but for all the geologists of Ohio.

HONORARY MEMBERS OF THE ROYAL INSTITUTION

AT the centenary celebration of Faraday's discovery of benzene held at the Royal Institution on June 16, the new honorary members were introduced by the secretary, Sir Arthur Keith, in the following words:

Gabriel Émile Bertrand, professor of biological chemistry at the Sorbonne, Paris, and director of the laboratory of biological chemistry at the Institut Pasteur. Professor Bertrand is distinguished as an inquirer into bacterial activity, particularly in connection with oxidation phenomena, of which he has made a special study. He has also paid great attention to the influence of minute quantities of metals not usually regarded as acting upon the course of vital change.

Ernst Julius Cohen, professor of general chemistry and inorganic chemistry in the University of Utrecht, Holland. Professor Cohen is an acknowledged leader in physical chemistry, the biographer in England of his master, Van't Hoff, and like him, a devoted student of Byron.

Piero Ginori-Conti, senatore, president of the Associazione Italiana de Chimica, Generale ed Applicata, Rome. Prince Ginori-Conti has acquired distinction by capturing natural steam and using it as a source of energy, at the same time extracting from it large quantities of boric acid. He manufactures perborates from this latter by Faraday's method of electrolytic oxidation.

James Flack Norris, professor of organic chemistry in the Massachusetts Institute of Technology, and secretary of the American National Research Council. Professor Norris is president of the American Chemical Society, a constituency of 15,000 chemists. He is professor in the most noted of American technical schools, the Massachusetts Institute of Technology, and himself a well-known original worker.

Joji Sakurai, president of the Japanese National Research Council, emeritus professor of the Imperial University of Tokyo, Japan, and member of the Japanese House of Peers. Professor Sakurai was a student under the late Professor A. Williamson at University College, London, one of the first small band of Japanese students who came to Europe to acquire a knowledge of western science. Working upon foundations laid by the late Professor Divers, he has long been noted as the inspiring mind in Japanese chemistry. A founder of the National Research Council of Japan, he is now actively engaged in promoting the application of science generally in his country.

Frederic Swarts, professor of chemistry in the University of Ghent, Belgium, and member of the Royal Academy of Belgium. Professor Swarts is the son and successor of the successor of Kekulé in Gand. His father was Kekulé's assistant at the time (1868) Sir James Dewar worked in Gand, together with Körner, celebrated as the first to disclose the value of Kekulé's benzene symbol. Professor Swarts is distinguished as a student of the organic compounds of fluorine.

PREPARATIONS FOR THE KANSAS CITY MEETING OF THE AMERICAN ASSOCIATION

ARRANGEMENTS for the approaching annual meeting of the American Association for the Advancement of Science and associated organizations, which will be held in Kansas City from December 28 to January 2 next, are being made. Dr. A. Ross Hill is chairman of the local committee for the Kansas City meeting and the secretary of the committee is Mr. W. M. Symon, manager of the convention bureau of the Kansas City Chamber of Commerce.

The general headquarters for the American Association will be at the Muehlebach Hotel. Other hotels, furnishing adequate additional accommodations for all who attend the meeting, will be available within two blocks of this hotel.

The association is assured of the usual reduced railway rates (a fare and a half for the round trip, certificate plan, as heretofore) for many railway lines and it is expected that the reduced rates will be available for most of the United States and Canada.

Each section of the association is to have a local representative, who will look after the interests of the section and the associated societies that meet with it. The local representatives are as follows:

Section A (mathematics). Professor Eugene Mitchell, 1313 Massachusetts Ave., Lawrence, Kansas.

Section B (physics). Mr. Ben F. Eyre, 306 Land Bank Bldg., Kansas City, Mo.

Section C (chemistry). Professor Herman Schlundt, University of Missouri, Columbia, Mo.

Section D (astronomy). Dr. D. E. Haynes, University of Missouri, Columbia, Mo.

Section E (geology and geography). Dr. H. A. Buehler, Rolla, Mo., *chairman;* Mr. Vernon F. Masters, 123 Railway Exchange Bldg., Kansas City, Mo.

Section F (zoological sciences). Dr. H. H. Lane, Zoology Department, University of Kansas, Lawrence, Kans.

Section G (botanical sciences). Professor Albert Saeger, Junior College, Kansas City, Mo.

Section H (anthropology). Dr. C. A. Ellwood, University of Missouri, Columbia, Mo.

Section I (psychology). Dr. W. A. Andrews, Kansas State Agricultural College, Manhattan, Kans.

Section K (social and economic sciences). Mr. N. S. McKelvy, 1022 West 54th St., Kansas City, Mo.

Section L (historical and philological sciences). Mr. Purd Wright, Public Library, Kansas City, Mo.

Section M (engineering). Mr. J. F. Porter, President, Kansas City Power and Light Co., 1330 Grand Ave., Kansas City, Mo.

Section N (medical sciences). Dr. W. W. Duke, 1814 Federal Reserve Bank Bldg., Kansas City, Mo.

Section O (agriculture). Professor W. A. Cochel, Central Shorthorn Breeders' Association, Hotel Baltimore, Kansas City, Mo.

Section Q (education). Mr. George Melcher, 226 Library Bldg., Kansas City, Mo.

Dr. M. I. Pupin, professor of electromechanics at Columbia University, will preside over the general sessions. At the opening session on the evening of Monday, December 28, the retiring presidential address will be given by Dr. J. McKeen Cattell, editor of SCIENCE. Tuesday evening will be devoted to the fourth annual Sigma Xi lecture, which will this year be given by W. M. Jardine, secretary of agriculture. On Wednesday afternoon will occur the third Josiah Willard Gibbs lecture of the American Mathematical Society, which will be given by Professor James Pierpont, of Yale University. It is planned that an evening general session will be devoted to several invited papers arranged by the Committee of One Hundred on Scientific Research.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENTIFIC NOTES AND NEWS

DR. IRVING LANGMUIR, of the General Electric Company, has been awarded the Cannizzaro Prize of the Royal National Academy of the Lincei, Rome.

DR. ROSS G. HARRISON, Bronson professor of comparative anatomy and director of the Osborn Zoological Laboratory at Yale University, has been awarded a John Scott Prize of $1,000 and a bronze medal by the Board of Directors of City Trusts, Philadelphia.

CAPTAIN WILLIAM S. EICHELBERGER, of the United States Naval Observatory, has been elected an associate of the Royal Astronomical Society.

E. F. W. ALEXANDERSON, consulting engineer of the General Electric Company, was decorated by the King of Sweden on July 2 with the Order of the North Star, the highest decoration. The decoration was part of the ceremony in connection with the official opening of Sweden's new high-powered radio station at Varberg.

ASSOCIATE PROFESSOR F. D. MURNAGHAN, of the Johns Hopkins University, has been elected a member of the London Mathematical Society.

ELMER AMBROSE SPERRY, president of the Sperry Gyroscope Company, and Samuel Insull, president

of the Commonwealth Edison Company of Chicago, versity at its sixty-seventh annual commencement. were awarded honorary degrees by Northwestern Uni-

DR. FRANK B. JEWETT, president of the Bell Telephone Laboratories, has had conferred upon him by Dartmouth College the honorary degree of doctor of science.

THE honorary degree of doctor of science has been conferred upon Dr. John M. Dodson, professor of medicine in the Rush Medical College and editor of *Hygeia,* and upon Professor Louis H. Pammel, professor of botany at the Iowa State College, by the University of Wisconsin.

RECIPIENTS of honorary degrees conferred by the University of Michigan include the following: Professor Paul H. Hanus, of Harvard University; Dr. Edward Samuel Corwin, of Princeton University; Dr. Elwood Mead, of the Bureau of Reclamation, Washington, and Dr. Arthur R. Cushny, of the University of Edinburgh.

AT the commencement exercises of Loyola University, honorary degrees were conferred on Dr. Richard Tivnen, of the American College of Surgeons; Marinasuki Chiwaki, dean of the Tokio Dental College, and Florestan Aguilar, dean of the National Dental College of Spain.

THE following members of Stanford University will retire this year under the sixty-five-year age limit rule: Professor Douglas H. Campbell, of the department of botany; Professor Charles H. Gilbert, of the department of zoology; Professor Leander H. Hoskins, of the department of applied mathematics, and Dr. George C. Price, of the department of zoology.

DR. DAVID EUGENE SMITH, professor of mathematics at Teachers College, Columbia University, will retire at the end of the first semester of 1925–26.

DR. WILFORD M. WILSON, chief of the United States Weather Bureau Station at Cornell University and professor of meteorology, has been made professor emeritus.

ABOUT two hundred physicians gave a banquet in Chicago on June 23 to Dr. Dean Lewis, who will leave in the near future for Baltimore, where he has accepted the chair of surgery at the Johns Hopkins University Medical School.

DR. P. I. WOLD, professor of physics at Union College, has been elected president of the Union College chapter of Sigma Xi.

AT the ninth annual meeting of the Association for the Study of Internal Secretions at Atlantic City on May 26, Dr. J. B. Collip, of Edmonton, Alta., Canada, was elected president; Drs. Frederick S. Hammett, Philadelphia, and Eugene F. Du Bois, New York, vice-presidents, and Francis M. Pottenger, Monrovia, Calif., secretary-treasurer.

DEPUTY GIUSEPPE BELLUZZO, professor at Milan Polytechnic Institute, and a well-known engineer, has been appointed minister of national economy, in the Italian cabinet.

DR. WILLIAM AUSTIN CANNON, research associate of the Carnegie Institution, stationed at the Desert Botanical Laboratory, Arizona, has been transferred to Stanford University to conduct experiments on the relation of roots and grasses to the soil and atmosphere.

AT Brown University, Assistant Professor R. W. Burgess has resigned and will continue the work with the general statistical department of the Western Electric Company which he has been doing during the current year while on leave of absence.

DR. MURRAY P. HORWOOD, assistant professor of biology and public health in the Massachusetts Institute of Technology, will conduct a tuberculosis survey of Boston this summer for the Boston Tuberculosis Association.

CAPTAIN CHARLES M. ROGERS, professor of pharmaceutical chemistry and Lieutenant J. Lewis Maynard, instructor in chemistry at the University of Minnesota, both members of the United States Chemical Warfare Service, have been attending a fifteen days intensive training school for chemical warfare officers of the organized reserves, United States Army, at Fort Logan, near Denver. Captain Rogers is gas officer of the 88th division.

DEAN H. R. MANN, of the State College of Agriculture at Cornell University, has left for Europe, where he will represent the International Education Board at various scientific meetings abroad.

DR. PAUL S. WELCH, associate professor of zoology in the University of Michigan, has been granted leave of absence for the academic year 1925–1926. He will spend the year in Europe visiting the principal universities, museums, research institutes and biological stations.

DR. ALEXANDER HAMILTON RICE and the other members of the exploring party to South America returned to New York on July 10.

DR. JOHN J. ABEL, professor of pharmacology at the Johns Hopkins University Medical School, recently gave two public lectures under the auspices of the North Carolina Chapter of the Society of the Sigma Xi, on "The importance of the apparently negligible in biology and medicine."

DR. W. W. CAMPBELL, president of the University of California, gave the Halley lecture at Oxford University on June 17.

A PORTRAIT of William Harvey, discoverer of the circulation of the blood, attributed to Van Dyck, has been presented to Jefferson Medical College by Dr. J. Ackerman Coles, Newark, N. J., in memory of his father. It was a possession of Oliver Wendell Holmes, who for years was professor of anatomy at the Harvard Medical School.

PROFESSOR GILBERT VAN INGEN, since 1908 assistant professor of geology at Princeton University, died on July 9, aged fifty-five years.

UNIVERSITY AND EDUCATIONAL NOTES

THE board of trustees of Indiana University have made available sums totaling $700,000 for improvements in the medical school and a university library. The funds to be used for the medical school were derived from a gift of $375,000 from William E. Coleman, Indianapolis; a gift of $6,000 from the Eli Lilly Company, of Indianapolis, and from the sale to the state of the building formerly used by the medical college, for $100,000.

RECEIPT of a gift of $250,000 from Mrs. Stephen V. Harkness, completing the $1,000,000 fund raised by the Presbyterian Hospital nurses for the new school of nursing at the Presbyterian-Columbia Medical Center in New York, has been announced by the board of managers of the hospital. Mrs. Harkness's cash gifts to the medical center now total $800,000.

BY the will of the late William J. Cooper, of Camden, N. J., Swarthmore College will receive $100,000 for the establishment of a memorial lecture fund.

GEORGE WILKINSON CASE, formerly professor of sanitary engineering at the University of Pittsburgh, has been appointed dean of the college of technology and professor of mechanical engineering.

PROFESSOR A. A. BENNETT, of the University of Texas, has been appointed professor and head of the department of mathematics at Lehigh University.

DR. C. DALE BEERS, Ph.D., Johns Hopkins University, and Dr. Harold Kirby, Jr., Ph.D., University of California, have been appointed instructors in biology at Yale University.

DR. HANNAH E. HONEYWELL, formerly of Columbia University and of the Carnegie Station for Experimental Evolution, Cold Spring Harbor, L. I., has been appointed assistant professor in agricultural and biological chemistry at the Pennsylvania State College.

DR. MARION HINES LOEB, assistant professor of anatomy at the University of Chicago, has accepted the position of associate in anatomy at the Johns Hopkins University Medical School.

DR. HALBERT DUNN, Ph.D. (Minnesota, '23), of the Mayo Clinic, has been appointed associate professor of biometrics in the School of Public Health at the Johns Hopkins University.

PROFESSOR LOUIS WADE CURRIER, assistant professor in mineralogy at Syracuse University for the past four years, has been elected to a similar position in mineralogy at the Missouri School of Mines.

DR. THOMAS ALTY, lecturer in physics at Durham, has accepted an invitation to a chair of physics in the University of Saskatchewan.

DISCUSSION AND CORRESPONDENCE

THE DEMONSTRATION OF NEPHROSTOMES IN THE EARTHWORM

WITH the exception of the testes, probably the most difficult structures to demonstrate in the earthworm are the nephrostomes, or funnels of the nephridia. If the removal of a nephridium is attempted either in a living or in a preserved worm, usually the postseptal portion is the only part secured. The delicate tube is readily torn at the point where it passes through the anterior septum. As a result the preseptal part remains when the postseptal portion is removed. The form of the nephridium is difficult to make out in its normal colorless or nearly colorless condition. The following method has been used successfully to demonstrate the entire nephridium *in situ*. It also simplifies the removal of the entire organ for the purpose of making permanent whole mounts.

A solution of vital methylene blue in distilled water, concentration 1:1000, is drawn into a hypodermic syringe, or into an ordinary dropping pipette whose tip has been heated and drawn out to a fine point. A large specimen of *Lumbricus terrestris* is held firmly in the hand and the needle of the syringe or pipette pushed through the dorsal wall of the worm approximately in the region of the tenth segment. The needle is then turned to a position parallel to the dorsal surface and pushed posteriorly for a distance of ten or twenty segments. The dye is forced into the coelomic cavity with pressure sufficient to render the worm decidedly turgid in the segments affected. The needle is slowly withdrawn, pressure being maintained during the withdrawal. In this way the coelomic cavity in each of several segments becomes gorged with dye.

After ten minutes the worm is killed with chloroform vapor and covered with water. A median dorsal incision is made, the body wall pinned out, and the digestive and reproductive organs removed. The nephrostomes are seen distinctly as deep blue structures. Other parts of the nephridia are colored somewhat less intensely. If one wishes to make an entire nephridium stand out more clearly, the preparation is removed from the water, moistened with a few drops of the dye and exposed to the air for ten minutes. As a result of this treatment the entire nephridium is clearly delineated and, when covered with water, may be examined under the hand lens or the binocular microscope. The preparation will remain in good condition for several hours.

If a permanent mount is desired, the organ is carefully excised, and fixed in an 8 per cent. solution of ammonium molybdate. The usual treatment of tissues stained intra vitam with methylene blue is then followed. A simpler way is to fix in corrosive acetic or any other general fixing solution, stain with Delafield's haematoxylin and with eosin, dehydrate, clear and mount in the usual way. The presence of methylene blue in the tissues does not interfere with the use of other stains, since it is decolorized by the acid of the fixing solution and is extracted by the alcohols during dehydration.

ELBERT C. COLE

WILLIAMS COLLEGE

PROFESSOR O. C. MARSH AND PITHECANTHROPUS

I DESIRE to call attention to a statement in the chapter on "Animal evolution" in "Contributions of Science to Religion," by Dr. Shailer Mathews. On page 200 is the following statement:

> Some question as to the authenticity of the published account of the remains of *Pithecanthropus erectus* arises out of the fact that their custodian, Dr. Dubois, will not permit its further study by his colleagues. The extreme fragility of these valuable relics is perhaps sufficient extenuation for what might appear to be a selfish attitude.

A footnote is appended as follows:

> Since this was written news has reached us that at least one leading American anthropologist has been permitted to examine the *Pithecanthropus* remains; but no report has been made public.

Remembering an article which I had read in the *American Journal of Science,* but not having present access to files of that journal, I asked Miss Lowes, librarian of Washington and Jefferson College, to look up the reference for me, which she has kindly done. It will be found on page 475, Vol. I (4th series), 1896, *American Journal of Science* (Silliman's journal).

The paper, as I remember it, was illustrated with figures of the cranium, femur and molar; and in it Professor Marsh states that at the meeting of the International Zoological Congress, in Leyden, September, 1895, Dr. Dubois, a half an hour before reading his paper, invited him and Professor Flower, of England, to examine the *Pithecanthropus* material; further, that both he and Professor Flower were in agreement with the conclusions of Dr. Dubois.

If any one will take the trouble to examine the files of the *American Naturalist* for the years 1895–96 he may be able to confirm my recollection of the opinions of two eminent scientific men concerning *Pithecanthropus,* Professor E. D. Cope, then editor of the *Naturalist,* and Dr. Harrison Allen. Professor Cope, the comparative anatomist, did not look upon Dr. Dubois's specimens as simian, but was inclined to refer them to the race of Neanderthal men. On the other hand, Dr. Allen, the human anatomist, saw nothing human in the remains. Of course neither of them had had the opportunity which Professor Marsh later enjoyed, of examining the material. One might, however, conclude, from this disagreement of two eminent authorities in their several lines, that their different opinions really tended to confirm Dubois's decision that *Pithecanthropus* is "neither beast nor human," but a veritable missing link, even if in a more or less collateral line.

My reason for making this communication is not for the purpose of criticising the chapter on "Animal evolution," which is an excellent presentation of the subject, nor of the volume of which it is a part, which is an admirable and timely contribution to the literature of these atavistic times, but to do what I can to render innocuous any use that might be made of the oversight by the "energetic ignorance" of the present day.

I have lately had occasion to read some of the present-day anti-evolutionary literature, and have been much impressed by its similarity to the erratic writings of opponents of animal experimentation, vaccination and the like. There is displayed the same facility in special pleading and the same disregard of facts. While it is not possible for one to say truthfully of these eccentric people that they are "ever learning," one may be permitted to say that they seem to be "never able to come to a (full) knowledge of the truth."

Of some of these anti-evolution writers I think that it should be said that they write with the best of intentions, albeit, it must be owned, not always in the best of tempers. If any such should chance to see

this communication, I hope, after they have verified the reference, that they will refrain from making unjust charges against Dr. Dubois.

It is not for the anti-evolutionists, however, that I make this contribution, but rather for the information of those who, in these days when state legislatures are attempting to settle scientific questions by majority vote, are called on themselves to be energetic champions of the truth.

And, speaking of state legislatures, while I have not seen the text of the anti-evolution law enacted by the law-makers of the state of Tennessee, and which is impending in other states of the Union, I presume that they have had the foresight to make it illegal for human skeletons, in museums and schools which are supported by public funds, to wear their coccygeal bones.

EDWIN LINTON

AUGUSTA, GEORGIA

FAUNA HAWAIIENSIS

BERNICE P. BISHOP MUSEUM, Honolulu, has on hand a number of incomplete sets of Fauna Hawaiiensis. The following numbers will be sent to libraries or individual scientists on receipt of twenty-five cents in stamps to cover the cost of postage on each volume: Volume I, Nos. 4, 5, 6; Volume II, No. 6; Volume III, Nos. 3, 4, 5, 6. Bishop Museum Memoir, Volume VII, No. 2 (Monographic study of the tribe Lobeloideae, by Joseph F. Rock, 395 pages, 217 plates) may also be obtained for the cost of mailing, forty-five cents.

HERBERT E. GREGORY

BERNICE P. BISHOP MUSEUM

QUOTATIONS

THE ANTI-EVOLUTION TRIAL IN TENNESSEE

THE mortification which most educated Americans feel about the Dayton trial has at least one offset. This challenging of the truths discovered by scientific inquiry yields at any rate this advantage, that it gives scientific men a better opportunity than they ever had to bring their teaching home to millions. They can unfold the evidence for what they believe, and can get a wider and more interesting hearing for it. Elsewhere in the *Times*, for example, Dr. Henry Fairfield Osborn states, summarily but effectively, the anatomical and geological proofs of the descent—or ascent—of man. This will undoubtedly be read with an attention that could not have been elicited from the general public had not Mr. Bryan made his ignorant and intolerant assaults upon those who accept evolution as the method of creation.

He has, in reality, given to scientists and teachers a splendid chance. They will now have a larger and more alert popular audience than they have ever known. Such an opportunity for popularizing, in the best sense, scientific truths can rarely have presented itself. Let it be improved by men ready to give the reasons for the faith that is in them. They can explain in a way intelligible to the ordinary mind the process of engrafting the theory of evolution upon all modern thought. They can show how it is to-day the presupposition of inquiring minds in all departments of knowledge. It is taken for granted in every laboratory. It is a part of the baggage which every explorer carries with him into unknown lands. It is the indispensable tool of the modern investigator and the modern philosopher alike. It is the great working hypothesis of science everywhere. Educated men think unconsciously in terms of evolution. The idea of it and applications of it are woven into the intellectual life of the whole world to-day.

All this can be set forth, with the evidence for it and the human benefits to be derived from it, and then the ignorant defiance from Tennessee can be met by the poet's indignant assertion that it is "shame to stand in God's creation and doubt truth's sufficiency."
—N. Y. *Times*.

SCIENTIFIC BOOKS

The Cell in Development and Heredity. By EDMUND B. WILSON, professor of zoologoy in Columbia University. Third Edition, Revised and Enlarged. The Macmillan Co., 1925.

THE grateful and enthusiastic student of cytology can paraphrase Emerson's exclamation concerning Plato by saying of this book: "In Wilson are all things (concerning cells) whether written or thought." The former editions of this work have been recognized for a generation throughout the world as the most valuable and important books on this important subject, and the present volume, coming a quarter of a century after the last previous edition, represents the enormous advances in our knowledge of cytology which have been made during this period—a development that has probably not been surpassed by any other science during the same time.

Students of cytology have known for a long time that Professor Wilson was preparing a new book and they have been waiting anxiously for its appearance. The present volume more than justifies all expectations. It is, in fact, an entirely new book; the arrangement of materials, the topics treated, even much of the terminology is different from that in the old edition, and the book has grown from nine chapters and 483 pages, in the second edition, to fourteen

chapters and 1,232 pages in the present one.[1] Even this statement does not fairly represent the relative size of these two editions, for the former edition was printed in eleven point type, while the present one is in ten point, and the figures, on the whole, have been reduced about one third in size as compared with the previous edition. (The number of figures has grown from 194 to 529, and many of the figures of the old edition have been entirely redrawn). This reduction in size of type and figures is the one and only respect in which the new edition compares unfavorably with the old, but this reduction, as well as the much thinner paper used, was necessary in order to bring the work into a single volume, which, in spite of its more than 1,200 pages, is less than two inches thick.

The year 1900, in which the second edition of "The Cell" was published, marks an epoch in the history of biology, for in that year Mendel's law of heredity was rediscovered; only two years later Wilson and his pupils had established the fact that the basis of Mendelian segregation lies in the separation and distribution of maternal and paternal chromosomes in the maturation of the germ cells. Although there was abundant evidence before 1900 that chromosomes were the bearers of inheritance factors, this evidence was general rather than specific, but with the discovery of the cellular basis of Mendelism, this evidence became not only specific but for the first time cytology became a leader rather than a follower in the study of genetics. Again in 1902 to 1905 Wilson and his pupils demonstrated that sex in certain insects is determined by the distribution of particular chromosomes to the germ cells, thus solving one of the oldest and most perplexing problems in the whole realm of biology. Finally, on the basis of this work, Morgan and his associates, working in close relations with Wilson, discovered not only the details of the "architecture of the germ plasm" but also some of the most important features of the cellular mechanism of heredity, variation and evolution. These discoveries represent the high points in the progress of biology during the present century, and of all of them Wilson could truthfully say, though his well-known modesty would forbid, "All of which I saw and much of which I was." This book has been written out of this experience; it represents not only the mature point of view of the world's leading student and teacher of cytology, but it is to a large extent the work of its leading investigator in this field.

It would be impossible in the space appropriate to a book review to deal at all thoroughly with the contents of a book of this size and character; the most that can be done is to point out some of the more general features and conclusions. In the preface Professor Wilson says that the book has been written from the standpoint of a zoological student of cytology and embryology; consequently emphasis is placed on the zoological and embryological phases of cytology rather than upon the botanical, histological, pathological, biophysical or biochemical aspects, though all of these are dealt with in more or less detail. The author says also that, while holding in view the needs of technical students and teachers of the subject, he has tried not wholly to lose sight of the interests of more general readers. But the subject of cytology is such a *terra incognita* even to scholars in other fields that it is doubtful whether clear ideas can be conveyed to those who have never seen cells under a microscope, and the terminology is so strange and forbidding that the general reader would need to be a capable and serious student to undertake to read such a book as this—despite its beautiful style and the excellent glossary of more than twenty-four pages of distinctively cytological terms. But for students and teachers of cytology the book is indispensable; it is a handbook, encyclopedia and guide to practically all important work that has ever been done on cells. For years to come it will be the Bible of cytology, for in all probability there can never again be a single *inclusive* volume on this branch of science. The book is well documented by footnote references on almost every page, by two or three pages of special references at the end of each of the fourteen chapters and by fifty-eight pages of closely printed general references at the end of the volume. There is an excellent author's index of twelve pages and a subject index of sixteen pages which make it relatively easy to find any reference, topic or illustration in the book.

In a book of such extent as this is, there are naturally many minor features which could be criticized and a number of errors, typographical or otherwise. Most of these are easily detected and would be of more interest to a printer than to a biologist. However, there are a few errors of a more serious character. Wilson himself has called attention to an error at page 758 with respect to the sex chromosomes of a sea urchin, as determined by Tennent, Baltzer and others (SCIENCE, February 13, 1925). The most serious error that I have noted is on page 743 where it is stated that R. Hertwig found that "over-ripe eggs of frogs produce a large excess of females as

[1] The titles of the new chapters are: Chapter 3, "Reproduction and the life cycle"; Chapter 7, "Reproduction and sexuality in lower organisms"; Chapter 10, "Chromosomes and sex"; Chapter 11, "Morphological problems of the chromosomes"; Chapter 12, "Heredity and the chromosomes."

compared with those of the same female when fertilized immediately." A footnote from this passage gives the numbers of males and females from over-ripe eggs in one experiment as 13 males and 673 females; a reference to Hertwig's paper shows that the condition is exactly the reverse of that quoted, namely, over-ripe eggs give rise to this large excess of *males*.

In places there is a good deal of repetition which is probably unavoidable, owing to the method of treatment; for example, portions of the general history in the introduction are repeated in the special chapters. Several of the chapters show that they have grown by accretion rather than by intussusception, owing probably to the fact that new work had to be added to chapters already written. The terminology of cytology is relatively unfamiliar and complicated and it ought to be simplified as far as possible; it is unfortunate that in this standard work all superfluous synonyms were not suppressed and a single uniform system of terms adopted throughout the text. For example, about five hundred cytological terms are listed in the glossary, of which at least one hundred are synonyms and probably another hundred are of no real service. The invention of new names in cytology is akin to the introduction of new specific names in taxonomy; it is an easy road to immortality,—if they stand. In a great work such as this it is highly desirable that synonyms and superfluous terms should be defined and authority for them cited in the historical sections and in the glossary, as has been done in this case, but elsewhere they should be excluded from the text, for they serve only to complicate and confuse.

There is a peculiar charm in all Professor Wilson's writing, which is especially noticeable in the more general and theoretical portions of this book; this is in part due to excellent diction and style, but chiefly to an artistic quality that can best be described as stimulating to the scientific imagination. Of the many excellences of the book, perhaps the most notable are its breadth of view, judicial temper and eclectic spirit. The views of different authors are presented fairly and judged impartially, and where evidence is conflicting conclusions are stated with scientific caution. Even in matters where Professor Wilson's own investigations have been most unambiguous, as, for example, on the determination of sex, he does not attempt to force all cases into a single mould. His is not "a single-track mind," but rather one of many tracks not always parallel, but all of which lead to certain general termini. Furthermore, he nowhere leaves the impression that final solutions of any problem have been found; even the most satisfactory solutions are incomplete and tentative, and back of the known is an infinity of the unknown.

In my review of the second edition of "The Cell" I called attention to the fact that the book-mark on the cover of the first edition had been changed from a mitotic figure in the metaphase to one in the anaphase, and expressed the hope that we might see "still other editions, telophases and yet other cycles of development in the future." This is the telophase of Wilson's "Cell"; if there should ever be another edition it is safe to predict that it will have divided into two. Probably no singe book can ever again deal so comprehensively and judicially with the whole field of cytology. Few other workers are left who were in at the birth of this science and who can speak of its development with the knowledge that comes from intimate contact with persons and problems. It is a monumental work, one of the most complete and perfect that American science has produced in any field, and biologists throughout the world will unite in extending thanks and congratulations to its author on the successful completion of a great work which will always stand as a golden milestone on the highway of biological progress.

E. G. CONKLIN

PRINCETON UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

COMPENSATING THE UNEMPLOYED EYE IN MONOCULAR INSTRUMENTS

WHEN using a hand-lens, an ordinary single-tube microscope, or any other optical instrument made for one eye, three points at least may be considered with regard to balancing the two eyes: (1) The intensity and angle of the light passing through the two pupils may be made roughly equal, so that the two irises may not tend to be in conflict with regard to contraction or expansion; (2) an arrangement may be made to facilitate the axes of the two eyes converging to the same point, this point is best, in many or most cases, if situated at an indefinite distance; (3) the accommodation of the two eyes, which is more or less linked with their convergence, may be kept approximately the same.

The beginner with the microscope, as every one knows, has troubles because the unoccupied eye persists in seeing. If an opaque shade is placed in front of it, or if it is closed, matters are not better. The well-known rule is to keep the unemployed eye open, and to gradually learn to neglect everything it sees. More or less temporary diplopia often results. Also, in the course of years, the unemployed eye commonly sees less and less, and may in time

become partially blind. The remedy is to change the eye at the tube; but this change is rarely made, because of initial difficulties.

If a translucent, but not transparent, screen is placed over the unemployed eye, and the requisite time allowed to get used to it, the following advantages may result: (1) The intensities of the light reaching the two eyes may be roughly balanced by putting a sheet of white paper on the table under the unemployed eye; (2) there is nothing to lead the unemployed eye astray, and prevent it from converging with the other, or to keep their axes from being parallel; (3) the accommodation of the two eyes can change together, since the translucent screen prevents the unemployed eye from fixing on near objects; (4) if it is desired to change the observing eye, the screen may be arranged so that there is a constant reminder as to which eye is to be used. After observing with the right eye for years, it is possible to change to the left eye in a month or two, so that this eye gives images good enough for routine work.

At slight expense one can prepare a screen which affords, after a few weeks of practice, much of the comfort of the binocular, while retaining the simplicity of the monocular. In some of the periscopes used in the late war it was found advantageous to use a blank eyepiece for the unoccupied eye. This gives fair results with the monocular microscope, but it is needlessly elaborate. In half an hour a frame can be cut out of sheet aluminum, with a circular aperture into which the eyepiece of the monocular fits snugly, while a disc of ordinary paraffin waxed paper covers the other circular aperture at the right interocular distance. The upper surface of the metal can be blackened, or a sheet of dark cardboard cemented to it. If an extension is left to serve as a handle, a meniscus, deep sphere, achromatic meniscus, Verant or Steinheil triple lens can be fastened in one aperture, while the other is shielded by the translucent screen. This gives, after practice, an increase of comfort in the use of a hand-lens or reading glass. If such a frame is fitted to a monocular prism field-glass, it gives a sense of ease. Finely ground glass may replace the waxed paper.

JOHN BELLING

DEPARTMENT OF GENETICS
CARNEGIE INSTITUTION OF WASHINGTON

SPECIAL ARTICLES

DISEASES OF THE RUFFED GROUSE

SPORTSMEN and bird students are taking an ever-increasing interest in the conservation of our game birds. They have accomplished much through the passage and strict observance of good game laws and have replenished areas which have been depleted of game by numerous introductions of new stock. Until recently however sportsmen have not coordinated their efforts in conservation with a definite plan of ornithological investigation. A comprehensive study of the ruffed grouse has now been undertaken. The problem is not a simple one and there is needed the cooperation of every one who is interested in the welfare and the future of the grouse. It is probable that disease may kill as many or more birds than do the guns of all the sportsmen in the country, but we can not hope to combat disease until we know more about it and its intricate relations in the life of the birds. During the course of life history studies now being made at Bowdoin College, Brunswick, Maine, and work conducted in southeastern New York during 1924 for the Roosevelt Wild Life Forest Experiment Station of Syracuse, certain diseases of the ruffed grouse have come to my attention. It seems desirable to make a preliminary report of the diseases found, at this time, as they probably have an important bearing on the sudden fluctuations in the numbers of the ruffed grouse. The author also hopes that this report may stimulate the desire of all persons interested to examine birds found dead and all birds killed which present symptoms of disease.

Thus far I have received eighteen birds in the flesh, two from New York, five from Connecticut, one from Rhode Island, two from Massachusetts and eight from Maine. Of these eighteen birds eight were killed and ten were found dead; of the latter, three had met death by violent plunges into buildings and one by flying into telephone wires. Two of the birds found dead died as the result of injuries received in some unknown way and seemed to be normal as far as the presence of any disease was concerned. None of the ten birds found dead had been shot.

The cases of parasites and diseases among the eighteen birds are: *Dispharynx* seven, *Ascaridia* two, pulmonary mycosis two, tuberculosis three and one bird died apparently from the results of a large abnormal growth dorsal to the abdominal viscera. The 44 stomachs examined were free from parasites. Following is a brief statement of the diseases.

DISPHARYNX (DISPHARAGUS; ACUARIA)

Dispharynx is a parasitic nematode worm which usually becomes established in the proventriculus, a glandular swelling at the base of the gullet, and in later stages spreads to the muscular walls of the stomach. The names *Dispharagus* and *Acuaria* have been used by various writers to designate this para-

site, but Dr. B. H. Ransom, of the U. S. Bureau of Animal Industry, the leading authority on this group, prefers to use the generic name *Dispharynx*. This parasite has been noted in the ruffed grouse by Dr. A. A. Allen in specimens which he examined at Cornell University, and according to Dr. Allen it has been the cause of death of some of his birds raised in captivity. Since it has a wide distribution from Michigan to Maine, Dr. Allen thinks it is the most important factor concerned with the present scarcity of the ruffed grouse. In nearly all the cases of *Dispharynx* examined at Bowdoin the infection was in its initial stages and I doubt if in any of the seven cases could the death of the bird be attributed solely to the presence of the worms. The seven cases represent five distinct localities and four different states, emphasizing the fact that the parasite is not local but spread over a very wide area. Two of the birds infested with *Dispharynx* had been shot. Two were found dead; in one *Dispharynx* was combined with pulmonary mycosis and in the other with tuberculosis. In the case of these two birds it is probable that the presence of *Dispharynx* so weakened their resistance that the diseases easily gained a foothoold. Three birds infested with this parasite killed themselves by flying violently against buildings. Every year the newspapers report numerous like cases of accidental death. It would be interesting to examine all birds which have killed themselves in this manner as some relation might be found to exist between the so-called "crazy flight" and the presence of the stomach worms. Others, including Dr. Allen, have examined similar cases. The parasites undoubtedly cause a severe irritation that may be the initial cause of this peculiar behavior.

ASCARIDIA LINEATA (SPECIES?)

This nematode worm is frequently found in the intestinal tract of grouse. It is a very common parasite of wild birds, but so far as I can ascertain has not been proved to be a serious menace to the host. Nevertheless, a thorough investigation should be made of these parasites, of which so little is known concerning their direct pathological effects and their possible bearing on various grouse diseases.

PULMONARY MYCOSIS

Mycosis is a general term applied to infections with Hyphomycetes, and in the cases under consideration it concerns the growth of *Aspergillus* in the lungs and air sacs of the birds. Mycosis is well known to breeders of poultry and ostriches under the name of brooder pneumonia. It also occurs among birds confined in zoological parks, but I know of no case on record where it has occurred in the ruffed grouse in nature.

The author is indebted to Dr. E. E. Tyzzer, of the department of comparative pathology, Harvard Medical School, for the determination of this disease in two specimens of ruffed grouse, one found dead at Stratford, Connecticut, and the other found dead near Union, Maine. These birds found in so widely separated localities indicate that the disease may be common and widespread during certain years when conditions are favorable for infections and for its growth.

AVIAN TUBERCULOSIS

Avian tuberculosis, like mycosis, is a common disease in poultry and in birds confined in zoological parks and gardens but is seldom found in free wild birds. Dr. Morton Grinnell reports finding the disease in three ruffed grouse which were kept in captivity for a period of six weeks before death.

I am indebted to Mr. B. B. Burbank for making microscopical preparations of a large series of tissues and for making the preliminary examinations of my material; and I am further indebted to Dr. F. N. Whittier, late professor of bacteriology of Bowdoin College, for the diagnosis of tuberculosis. Positive determinations were made on three specimens, one from Jackman, Maine, one from Millerton, New York, and the third from Granby, Connecticut.

Tuberculosis from the standpoint of human welfare is a most important disease, and if it is common and widespread among wild birds it should receive the attention of all who are interested in the ruffed grouse.

The few examinations thus far made emphasize the importance of autopsies of the entire bird. Most of the eighteen specimens received at Bowdoin were sent because disease was suspected, but even so there is a surprising number of diseases in this small number of birds. In addition to the diseases mentioned we need to give some attention to external parasites which may be the secondary hosts of some of the internal parasites or may prove to be the carriers of disease which would tend to spread and multiply the number of cases. If this be true certain phases of the life history of these external parasites may be correlated with the periodic decrease in the numbers of the ruffed grouse. It is very desirable to have an abundance of living material of both birds and parasites for extensive experimental work. It will be necessary to examine a large number of specimens, and a complete life history and ecological study extending over a period of several years must be con-

ducted before we can hope to make generalizations concerning the life of the ruffed grouse. I wish to express my appreciation for the splendid cooperation already given me by various sportsmen and by the conservation commissions of Connecticut, Massachusetts and Maine. The primary purpose of this preliminary note is to stimulate interest in the further investigation of all phases of an important ornithological problem.

ALFRED O. GROSS

ROOSEVELT WILD LIFE FOREST EXPERIMENT STATION,
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A BACTERIOLOGICAL NOTE RELATIVE TO THE FRANKLIN ARCTIC RELIEF EXPEDITION OF 1848

THROUGH the kindness of Mr. O. S. Finnie, director of the Northwest Territories and Yukon Branch of the Department of the Interior, Canada, the writer was given the opportunity of examining bacteriologically a specimen of pemmican found in a cache on Beachy Island, District of Franklin, Canada, by members of the Canadian Arctic Expedition of 1924. The cache was identified as having been established by one of the early Franklin Relief Expeditions, presumably that of 1848.

The pemmican was found hermetically sealed in a tin container, which bore no marks of origin, but in all likelihood was of English manufacture, as it had no resemblance to Canadian-made pemmican of that period. Upon removal from the tin, the pemmican block measured about eight-inch cube, was somewhat rust-incrusted and weighed almost ten pounds. This rusty incrustation being carefully pared off with a knife, the pemmican was found to be of a light brownish-yellow color and in an extremely dry condition. Currants were found embedded in the homogenous mass and were thoroughly desiccated, extremely friable and tasteless.

For bacteriological examination, a portion of the surface of the pemmican block was thoroughly seared with a hot iron, and with the aid of a sterile punch a portion about two and one half cm long was extracted and deposited in a sterile Petri dish. With a sterilized knife the outer four mm of this cylinder were carefully cut away and discarded. The remainder of the plug of pemmican was broken up with a knife into small fragments and the examination proceeded with.

Bacterioscopic examination: A small fragment of the pemmican was transferred to a slide and soaked with a small amount of sterile physiological salt solution. As soon as the material was thoroughly softened it was crushed and smeared over the slide, dried and stained with gentian violet. Under the microscope, examination demonstrated the presence of a moderate number and variety of rod-shaped forms of bacteria, together with two different types of micrococci. These latter organisms were grouped usually, in pairs, with an occasional cluster of four or five. A gram stain showed large and small-sized positively staining rod forms, fairly well impregnated; diplococci, both large and small sizes, were found positive in fair numbers, although some of the larger type were negative. Although sought for, no acid-fast rods could be recognized.

An attempt was also made to demonstrate the presence of spores of bacteria, but on account of the presence of considerable fat in the material, spores could not be identified with any certainty.

Bacteriological examination: 0.2 gm of the pemmican was weighed out, suspended in 10 cc of sterile salt solution and distributed in large fermentation tubes of dextrose broth, containing the usual amount of Andrade's indicator, and of a pH of 7.4. These tubes were incubated at 37° C. anaerobically in an atmosphere of hydrogen for 48 hours and examined. At the end of this period, one tube showed about 50 per cent. of gas, and the surface of the liquid in the bulb was covered with a heavy wrinkled felt-like growth. The contents of both the bulb and closed arm of the tube were strongly acid in reaction. The other three tubes gave no gas, but showed growth in both bulb and closed arm and were slightly acid in reaction. The surface of the bulb and contents of two of the tubes showed a felt-like growth, as in the tube containing gas, whereas the fourth tube, although cloudy, did not show this peculiar surface growth.

Without going into further technical details, it can be stated that the following bacteria were successfully isolated: *Bacterium welchii, Bacillus cereus* (Frankland) and *Bacillus subtilis* (three varieties). It was calculated from special data that the viable spore content per gram of pemmican was about 25 spores of *Bacterium welchii* and 300 spores of the hay bacillus group. These results are in general accord with what might have been anticipated, namely, that if there were any surviving forms of bacterial life, these would in all probability consist of viable spores only. As a check, however, the contents of these fermentation tubes were tested out on Endo's medium in the hope that possibly some non-sporing bacteria of the coli-aerogenes group might have survived, but none was found. The same endeavor was pursued by using a small portion of the pemmican made up into strong suspension in salt solution, but no growth appeared on any of the Endo plates.

Bearing in mind the possible existence of spores of

Bac. botulinus in the pemmican, 0.2 gm was incubated anaerobically for four days in dextrose broth at 37° C. and two mice were inoculated intraperitoneally with 0.2 and 0.4 cc of the broth filtered through a Berkefeld "V" filter, with entirely negative results.

It is proposed to deposit sub-cultures of these organisms with the culture collection of the Society of American Bacteriologists, under the care of Dr. Ludvig Hektoen, of the McCormick Memorial Institute, Chicago.

NORMAN MACL. HARRIS
DEPARTMENT OF HEALTH OF CANADA,
OTTAWA, CANADA

THE MICHIGAN ACADEMY OF SCIENCE, ARTS AND LETTERS

THE thirtieth annual meeting of the Michigan Academy of Science, Arts and Letters was held at Ann Arbor, April 1 to 3, 1925. The presidential address, "American botany during the colonial period," was delivered by Professor H. H. Bartlett. Dr. Edward Francis, of the United States Public Health Service, addressed the Academy on "Tularaemia."

The following program was presented:

GENERAL SESSION

Williams James Beal, 1883–1924: ERNST A. BESSEY.

Botanizing in the Himalayas: L. A. KENOYER.

American astronomical expeditions to the Southern Hemisphere: W. J. HUSSEY.

The Tanager Expedition of 1923 to Johnston and Wake Islands in the north tropical Pacific and its botanical results: JAS. B. POLLOCK.

SECTION OF ANTHROPOLOGY
E. S. McCartney, *chairman*

The influence of tales of the marvelous on Spanish exploration in America: A. S. AITON.

The natural science of the Australian native: E. F. GREENMAN.

Recent advances in prehistoric anthropology and archeology: E. C. CASE.

The heredity of head form: H. H. BARTLETT.

Religion at the Algonquian level: W. B. HINSDALE.

The protective power of red: H. A. KENYON

Notice of Dr. Hinsdale's "Primitive man in Michigan": E. F. GREENMAN.

Longevity and rejuvenation in Greek and Roman folklore: E. S. MCCARTNEY.

SECTIONS OF BOTANY AND ZOOLOGY
Joint Session

Variations and mutations in Pestalozzia guipina: CARL D. LA RUE.

The proportion of exceptions in the offspring of exceptional females from x-ray treatment of Drosophila: E. G. ANDERSON.

A dominant brown pericarp color in maize: E. G. ANDERSON.

A preliminary report on inheritance of fruit length in Capsicum: E. E. DALE.

Experiments concerning the coloration of pigeons: Read by title. JAN METZELAAR.

Genetics of color in Macrosiphum: A. FRANKLIN SHULL.

Some observations on the chondriosomes in the male germ-cells of Belostoma flumineum: A. M. CHICKERING.

A suggestion concerning the mode of inheritance of mental ability: H. R. HUNT.

Birth-rates in the families of the Michigan Agricultural College: C. V. GREEN and H. R. HUNT.

SECTION OF BOTANY
J. B. Pollock, *chairman*

The fungus flora of Mt. Hood, with some new species: C. H. KAUFFMAN.

Cultural life-histories of certain species of Eutypella, Diatrypella and Cryptovales: LEWIS E. WEHMEYER.

The life-history of Dimerosporium collinsii: GEO. B. SARTORIS. (Presented by C. H. Kauffman.)

On the distribution of the water molds, with notes on the occurrence in Michigan of members of the Leptomitaceae and Blastocladiaceae: BESSIE B. KANOUSE.

The reactions of the bean rust grown on leaves in solutions: CHARLES W. WATERS.

Rhizoctonias in culture: J. E. KOTILA.

Nutritive value of the Mung Bean: H. H. M. BOWMAN.

Rate of respiration in successive leaves of corn and sorghum: J. H. HOVER.

Growth curves in fruit of cucumber, tomato, summer squash and musk melon: F. A. GUSTAFSON.

The action of nutrient ions on certain enzymes in the sugar beet: DR. G. DOBY (visiting professor from Hungary), introduced by E. A. Bessey and R. P. Hibbard.

Further studies on the yield of corn as influenced by the date of planting: R. P. HIBBARD.

Studies of seed viability through the aid of electrical conductivity measurements. Preliminary report. R. P. HIBBARD and GEO. L. FICK.

Jane Colden, a pioneer in American botany: Read by title. H. H. BARTLETT.

Algae of the Douglas Lake region: ALMA B. ACKLEY.

The wild roses on and near the shore in the Mackinac region of Michigan: EILEEN W. ERLANSON.

The vegetation of the region of Douglas Lake, Michigan: I. Introduction, factors, general features and habits of the region: FRANK C. GATES. (Abstract presented by J. H. Ehlers.)

Meteorological data, Douglas Lake, Michigan, 1924: FRANK C. GATES. (Abstract by J. H. Ehlers.)

Enlarged bases in the black ash (Fraxinus nigra

Marsh) in Michigan: FRANK C. GATES and C. O. ERLANSON.

An ecological study of Smith's bog, Cheboygan County, Michigan: EDITH WOOLLETT, DORIS DEAN and HELEN COBURN.

Application of Gleason's formula to a Carex lasiocarpa association, an association of few species: EDITH WOOLLETT, DORIS DEAN and HELEN COBURN.

The development of vegetation in the Porcupine Mountains of Michigan: H. F. DARLINGTON.

Can America produce its own rubber? Read by title. CARL D. LA RUE.

Morphology of the seed in Claytonia virginica: E. F. WOODCOCK.

Notes on Indian ruderals: L. A. KENOYER.

The source of materials composing the coral reefs on Oahu, Johnston and Wake Islands; is it of plant or animal origin? JAS. B. POLLOCK.

Variations in fungi: G. H. COONS.

ECONOMICS SECTION
Z. C. Dickinson, *chairman*

The relation of the soil survey to land classification: L. R. SCHOENMANN. Discussion, J. V. Van Sickle (by invitation).

Forecasting the price of wheat: C. C. BOSLAND (by invitation). Discussion, L. R. Dewey.

Proportions of distinguished men furnished by rural and urban districts: ROY H. HOLMES (by invitation).

The recent discount and open-market policy of the federal reserve system: R. G. RODKEY (by invitation).

The trend of bond prices: L. A. MORGAN.

Competition between labor and machinery: GEORGE E. BIGGE. Discussion, L. E. DEVOL (by invitation).

The second industrial conference and the settlement of labor disputes: S. M. LEVIN.

SECTION OF GEOLOGY AND MINERALOGY
L. M. Gould, *chairman*

The geology of southern Mexico: W. A. VER WIEBE.

The influence of joints in the formation of the islands in the western end of Lake Erie: C. W. COOK.

The crystal structure of the pyrite group: L. S. RAMSDELL.

The evolution of the Jolly Balance: E. H. KRAUS.

Factors that determine the direction of ice movement: FRANK LEVERETT.

Preliminary statement on the relation of recessional moraines to Niagara Falls: FRANK B. TAYLOR.

The effects of high temperature and time in the production of artificial minerals: A. B. PECK.

On a specimen of Stylemys nebracensis, preserving the skull: E. C. CASE.

On a new species of the Eocene crocodilian, Allognathosuchus: A. wartheni: E. C. CASE.

The unstable middle sections of island arcs: W. H. HOBBS.

Greater Asia and isostasy: FRANK B. TAYLOR.

Geology as a factor in soil classification: J. O. VEATCH.

A preliminary report on the petrography of the Caroline and Pelew Islands: W. F. HUNT.

The petrography of some Sierra La Sal dikes: L. M. GOULD.

The pigments of amethyst and smoky quartz: A summary. E. F. HOLDEN.

Thermo-optical properties of Heulandite: C. B. SLAWSON.

Notes on a fulgurite from South Amboy, New Jersey: W. M. MYERS and A. B. PECK.

Two new crinoids from the Devonian of Michigan: G. M. EHLERS.

Some new species from the Richmond of Michigan: R. C. HUSSEY.

New brachiopods from the Mississippian of Wayne County, Kentucky: G. M. EHLERS and M. S. CHANG.

A laccolith in the air: L. M. GOULD.

On the probable cause of the earthquake in the northeastern United States, February 28, 1925: W. H. HOBBS.

SECTION OF HISTORY AND POLITICAL SCIENCE
A. S. Aiton, *chairman*

The Hispanic states and papal diplomacy before the year 1213: B. W. WHEELER.

The spirit and development of British administration in Michigan: NELSON V. RUSSELL.

The first St. Lawrence deepening scheme: GEORGE W. BROWN.

A reclassification of wars: PRESTON SLOSSON.

The ordinance-making powers of the French president: JAMES HART.

SECTION OF LANGUAGE AND LITERATURE
Oscar J. Campbell, *chairman*

Scholarship and the national drift in American literature: H. D. WILD.

The philosophy of Theodor Storm: On death: JOHN WILLIAM SCHOLL.

Muscular movement in the interpretation of speech phenomena: J. A. MUYSKENS.

Fugitive traces of self-portraiture in Wordsworth's "Excursion": PAUL MUESCHKE.

The influence of Spain on the French "Conteurs" of the sixteenth century: G. L. MICHAUD.

Slanging English words: R. W. COWDEN.

The rôle of Solomon in "The Song of Songs": LEROY WATERMAN.

Linguistics and biology: CLARENCE MEADER.

Crevecoeur and Thoreau: J. B. MOORE.

Hauptmann's "Promethidenloos": F. B. WAHR.

James Howell and Spain: C. P. WAGNER.

Favorite words: F. N. SCOTT.

SECTION OF MATHEMATICS
E. R. Sleight, *chairman*

(Program presented by the Michigan Section of the Mathematical Association of America)

Some new projective differential convariants of a congruence: HORACE L. OLSON.

On the origin of our number forms: T. W. FOULE.

The asteroids: LOUIS HOPKINS.

A college course in geometry for prospective high school teachers: GUY G. SPEAKER.

On a central-difference summation formula: WILMER JENKINS.

SECTION OF PSYCHOLOGY
F. L. Dimmick, *chairman*

Experimental work on maze learning: J. F. SHEPARD.

The use of the term "dynamic" in psychological literature: C. E. RAGSDALE.

The relative desirability of personality traits in social situations: C. S. YOAKUM.

Preliminary study in reasoning: E. B. SKAGGS.

The perception of the relative movements of two points of light: H. R. MAYBERRY.

SECTION OF SANITARY AND MEDICAL SCIENCE
C. C. Young, *chairman*

Surface tension and pellicle formation: M. S. MARSHALL.

Studies in the composition of the human fat: H. C. ECKSTEIN.

Fungi in relation to disease: ADELIA MCCREA.

The immunization of guinea pigs against Brucella melitensis infection: I. F. HUDDLESON.

Antigenic value of various tissue extracts in the Kahn test: PEARL L. KENDRICK and H. G. DUNHAM.

Keeping quality of standard Kahn antigen stored at different temperatures: PEARL L. KENDRICK and DORA JENKS.

Mutation of Bacteria: R. W. PRYER.

Leishmania donovani: M. H. SOULE.

A statistical study of 60,000 cases of venereal disease: W. J. V. DEACON.

Some interesting malformations: JAMES E. DAVIS.

An epidemiological study of the routine incidence of scarlet fever in Ingham Caunty in 1924–1925: I. M. LICKLY.

SECTION OF ZOOLOGY
H. M. MacCurdy, *chairman*

The Physidae of the Au Sable River, Michigan: W. J. CLENCH.

A collection of amphibians and reptiles from southern Indiana and adjacent Kentucky: FRANK N. BLANCHARD.

Life-history notes on fishes from southern Michigan: T. L. HANKINSON.

The metamorphosis of the California ribbon-fish, Trachypterus rex-salmonorum: CARL L. HUBBS.

The smelt: its introduction, distribution and life-history in the Great Lakes waters: CHARLES W. CREASER.

Remarks on the Genus Bachia: ALEXANDER G. RUTHVEN.

The Unione fauna of Lake Erie and its tributaries: BRYANT WALKER.

A phylogenetic and geographical study of the Gyrinidae: MELVILLE H. HATCH.

Odonata collected in Cheboygan and Emmett Counties, Michigan: C. FRANCIS BYERS.

The mammal fauna of a woodlot in Washtenaw County, Michigan: CHAS. M. DAVIS, JR.

Zoological groups in museums: H. L. WARD.

Symposium—The Zoological Resources of Michigan

Michigan's conservation fallacy: ALEXANDER G. RUTHVEN.

The inland lakes: PAUL S. WELCH.

The fishes: C. L. HUBBS and JAN METZELAAR.

The birds and mammals: L. R. DICE.

The following officers were elected for the ensuing year: *President,* Chas. H. Cooley, Ann Arbor; *Vice-president,* Frank B. Taylor, Fort Wayne, Indiana; *Secretary-Treasurer,* L. R. Dice, Ann Arbor; *Librarian,* W. W. Bishop, Ann Arbor; *Editor,* Peter Okkelberg, Ann Arbor.

Section chairmen: Anthropology, W. B. Hinsdale, Ann Arbor; Botany, L. A. Kenoyer, Kalamazoo; Economics, Z. C. Dickinson, Ann Arbor; Geology and mineralogy, L. S. Ramsdell, Ann Arbor; History and political science, S. James Hart, Ann Arbor; Language and literature, C. P. Wagner, Ann Arbor; Mathematics, E. R. Sleight, Albion; Psychology, E. C. Rowe, Mt. Pleasant; Sanitary and Medical Science, R. W. Pryer, Detroit; Zoology, H. R. Hunt, East Lansing.

L. R. DICE,
Secretary

THE OHIO ACADEMY OF SCIENCE

THE thirty-fifth annual meeting of the Ohio Academy of Science was held at the College of Wooster, Wooster, Ohio, April 3 and 4, 1925, under the presidency of Dr. Edgar N. Transeau, of the Ohio State University. More than one hundred registered as in attendance and a spirit of unusual earnestness seemed to pervade the meetings. Forty-six new members were elected and two members were made fellows in the academy, namely, Henry Curtis Beardslee, of Perry, Ohio, and Dr. Joseph H. Todd, of Wooster, Ohio.

The geology section of the academy held its usual field meeting and excursion in the vicinity of Cleveland on May 30, 31 and June 1, 1924, under the leadership of Professor J. E. Hyde, of Western Reserve University, for the purpose of studying the Devonian and Mississippian formations of northeastern Ohio, including the famous Berea and Amherst quarries, the Cleveland shale and its fossil fish and the lower part of the Waverly, especially the Berea grit.

Upon recommendation by the board of trustees of the research fund it was voted that "the income from $1,000 of the research fund be available each year for a grant to be known as the Emerson McMillin Grant, to be used either for assistance in some research problem or given as an award in recognition of some especially noteworthy contribution to science by some member of the academy." The balance of the fund and all income derived therefrom may be used or allowed to accumulate, as the board of trustees may

deem best, in any particular year, it being understood that the fund or any part thereof is to be used only for the encouragement of research, either by grants for individual problems or for the publication of papers resulting from research.

A detailed report on the history and present status of the matter of affiliation between the Ohio Academy of Science and the American Association for the Advancement of Science was submitted by Dr. A. E. Waller, treasurer of the academy, and after some discussion pro and con it was voted to refer the question of affiliation to the executive committee with power.

Upon recommendation of the committee on resolutions the following was unanimously passed by the academy, *viz.:*

The Ohio Academy of Science in annual session at Wooster, O., wishes to place itself on record as deploring the action of the Governor and Legislature of the State of Tennessee in connection with recent legislative enactments relative to natural phenomena. We believe the publicity thus developed will prove disadvantageous to the best interests of the state.

We desire, also, to express our sympathy for the teachers of science in Tennessee in connection with the handicaps under which they have been placed in the teaching of the truths of nature.

The committee on necrology reported the loss by death during the past year of four members, *viz.:* Charles W. Napper, Greenfield; A. D. Selby, Wooster; Septimus Sissons, Columbus; Herrick E. Wilson, Oberlin.

Officers were elected as follows: *President,* Paul M. Rea, Cleveland Museum of Natural History; *vice-presidents—zoology,* Clarence H. Kennedy, Ohio State University; *botany,* W. G. Stover, Ohio State University; *geology,* W. H. Shideler, Miami University; *medical sciences,* Samuel W. Chase, Cleveland; *psychology,* Harold D. Burtt, Ohio State University; *physical sciences,* Robert C. Gowdy, University of Cincinnati; *secretary,* William H. Alexander, U. S. Weather Bureau, Columbus; *treasurer,* A. E. Waller, Ohio State University.

The scientific program was as follows:

PUBLIC LECTURES

Invitation address on *The work of the Ohio Agricultural Experiment Station:* C. G. WILLIAMS, *director.*

Presidential address on *Accumulation of energy by plants:* DR. EDGAR N. TRANSEAU, Ohio State University.

PAPERS

Orchard spraying and human health: J. S. HOUSER.

Local lists of plants and animals: LYNDS JONES.

Modern ideas of soil development: G. W. CONREY.

Entomological conditions in Cuba: HERBERT OSBORN.

A biological basis of learning: H. M. JOHNSON.

Daily life of the American eagle; early phase: F. H. HERRICK.

Relation of temperature and rainfall to Hessian fly development: H. A. GOSSARD.

Seiches in Lake Erie and their ecological significance: F. H. KRECKER.

Repeated rejuvenations in hemp: J. H. SCHAFFNER.

The dynamic factor in heredity: A. B. PLOWMAN.

Monocular and binocular vision: PRENTICE REEVES.

A theory of nerve conduction and its application to imagination and habit: N. M. JOHNSON.

Intrarelationships of echinoderms as evidenced by ciliation: R. A. BUDINGTON.

The relation of the respiratory exchange to differentiation and dedifferentiation of obelia sp.: EMMETT ROWLES.

The sexual structures of polydesmus serratus: STEPHEN R. WILLIAMS.

The development of the male gonopods in euryurus erythropygus, Brandt; a polydesmid millipede: HUGH H. MILEY.

On the structure of a trematode of the genus eumegacetes found in the cloaca of the common tern at Put-in-Bay: JOSEPH N. MILLER.

The correlation of the seasonal history of the European corn borer with seasonal planting of corn: L. L. HUBER.

Aphids new to Ohio: C. C. CUTRIGHT.

Some reactions of pemphigus sp.: C. C. CUTRIGHT.

Exact determination of food requirements in bringing insects to maturity: E. R. BRYANT.

On the anatomy of the head and thorax in ranatra (Heteroptera): C. R. NEISWANDER.

The evolution of insects based on a study of the appendages: L. B. WALTON.

A biological record and classification card: L. B. WALTON.

The calorigenic effect of adrenalin: M. W. CASKEY.

Some observations on the architecture of the spongiosa of the calcaneus: S. W. CHASE.

Rickets and osteoporosis in swine as affected by nutrition; dietary factors: G. BOHSTEDT.

Rickets and osteoporosis in swine as affected by nutrition; pathology: B. H. EDGINGTON.

The effect of light on calcification of bone: R. M. BETHKE.

Some preliminary notes on the plankton of the Kartabo Region, British Guiana: HUGH M. RAUP.

Some factors which determine the size of the eye of drosophila: A. H. HERSH.

A note on wing venation in certain diptera: JAS. S. HINE.

Experiences and experiments in teaching embryology: BRADLEY M. PATTEN.

The fauna of a limestone spring in Cliff Park, Springfield, Ohio: HUGH M. RAUP.

The relative values of morphological adaptations: C. H. KENNEDY.

Relation of temperature to the physiology of the potato plant: JOHN BUSHNELL.

Some abnormalities in mnium: CHAS. H. OTIS.